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Title: Summary of the Containerization Portion of the Engineering Evaluation
in Support of EER 20180067LL

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Summary of the Containerization Portion of the Engineering Evaluation in Support of EER 20180067LL

An effort was undertaken between the LLNL DA and the LANL PA to demonstrate the ability to manufacture Mark Quality ER metal and evaluate the composition of the metal to WR standards in accordance with the LLNL DA compositional and isotopic requirements in 9R1341, (U) Ring. The verification of these requirements is being accomplished through an Engineering Evaluation (EE) of Chemistry-Actinide Analytical Chemistry processes as directed by Engineering Evaluation Release (EER) 20180067LL. The 9R1341 drawing also specifies requirements for the containerization of ER metal to support a one year shelf life (Note 7 of 9R1341). The objective of this note is to document efforts towards satisfying the containerization requirements in 9R1341.

Requirements

Requirements for the ER metal containerization portion of the EE are derived from Notes 2, 6B, and 6C in LLNL Drawing 9R1341 Issue B. Note 6B is listed below as two decomposed requirements.

1. **Note 2:** Mark Part Number and Serial Number per 9919100, Class H-1.
2. **Note 6B(1):** Container shall be pumped down to 1×10^{-1} torr before backfill.
3. **Note 6B(2):** Container shall be backfilled with an inert backfill gas with less than or equal to 40 ppm by volume diatomic nitrogen, 40 ppm by volume diatomic hydrogen, 40 ppm by volume diatomic oxygen, and 20 ppm by volume water.
4. **Note 6C:** Container shall have a leak rate less than 1×10^{-8} standard atm-cc/sec.

These requirements present some unique operational challenges for work in PF-4. First, ER metal at LANL historically has not been stored in a leak tight container, such that the requirement for a leak rate less than 1×10^{-8} standard atm-cc/sec necessitates the design, fabrication, and criticality safety evaluation of a container. Second, the leak test, evacuation, and backfill of a container to 9R1341 requirements requires integration into the existing infrastructure at LANL, which will require adjudication of a criticality safety issue.

Activities Supporting the EE

1. **[Storage Container]** A container, 157Y701733-000 Modified Fire Resistant Conflat, has been designed for this effort. The conflat is comprised of a 157Y701733-001 Conflat Flange, a 157Y701733-002 Conflat Half Nipple Weldment, and various commercially procured items (copper gasket, silver plated bolts, a valve, and various pipe fittings). The newly developed conflat represents a modification of the 55Y002941 1/2 Quart Conflat Container, Fire Test Configuration utilized by the PT-1 Group for the storage of ER metal. The 55Y002941 container is a ML1 container with a safety basis, whereas the 157Y701733-000 conflat is a ML4 container that requires a criticality safety evaluation before use with SNM.

The 157Y701733-000 drawing contains information to maintain traceability to the pedigree of the 55Y002941 conflat for the future possibility of economically generating a safety basis for the new conflat through some combination of equivalency analysis and test. The

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157Y701733-000 conflat provides a water resistant container consistent with PA-RD-01009 R9, *TA55 Criticality Safety Requirements* and the technical basis in LA-UR-15-22781, *Water Resistant Container Technical Basis Document for the TA-55 Criticality Safety Program*. Finally, the 157Y701733-000 conflat is covered as an approved inner container (class I-H-1) in PA-RD-01022 R1-IPC2, *TA-55 Nuclear Material Packaging Requirements*.

The 157Y701733-000 drawing package is maintained under change control and configuration management in yellow PDMLink as CREO electronic models and as a pdf file of signed copies of the drawings. The signed drawings also are maintained under configuration management in the LANL Electronic Document and Records Management System (EDRMS). The conflat will be incorporated in the LANL Master Equipment List.

2. **[Process Documentation]** The work authorizing document for this effort is PA-DOP-01118 R7, *Assembly Gas Operations*. The current version of the document requires minor modifications to accommodate the scope of work defined in the manufacturing work control document. The modifications have been incorporated into draft PA-DOP-01118 R8 but require adjudication (see paragraph 2 in the *Issues* section). PA-SPI-01173 R0, *Assembly Gas Operations – Leak Test, Evacuation, and Backfill of a Storage Conflat* is the approved manufacturing work control document for this effort. Both documents are maintained under configuration management in EDRMS.
3. **[Operator Training]** Operator training for Assembly Gas Operations is developed under PA-QS-01012 R1, *PF-4 Functional Programmatic Operator* and implemented through Curriculum #4251, *PF-4 Pit Assembler*. This curriculum comprises ten course modules and OJT #27180, *PF-4 Pit Assembler – Gas Process Operator*.

One fully qualified operator and three apprentice operators (one Process Engineer and two Operators) have trained to PA-SPI-01173 R0 and are available to execute the process in accordance with LANL Conduct of Operations. The SPI has been executed four times with minor corrections to process instructions after the first three evolutions; the SPI was executed to instruction on the fourth attempt.

4. **[Equipment Fabrication and Procurement]** One storage conflat for ER metal has been fabricated to 157Y701733-000 (Modified Fire Resistant Conflat). Leak test capability to the 9R1341 requirement ($<1 \times 10^{-8}$ standard atm-cc/sec) has been demonstrated on five occasions.

A process gas manifold has been fabricated to interface the storage conflat with Glovebox 380 (see Appendix 2 in PA-SPI-01173 R0). The process gas manifold currently contains a MKS Model AA07A13TCB2GT21 Pressure Transducer (SN 022411015), calibrated in accordance with ISO/IEC 17025:2005 using a documented procedure and NIST traceable standards. Unfortunately, the transducer gage resolution (1 torr) is not sufficient to verify Note 6B of 9R1341 (see paragraph 3 in the *Issues* section).

5. **[MRP Traveler]** A MRP traveler (LLNL-EE-MSP-01) has been generated to conduct the containerization and assembly gas operations portion of the EE.

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6. **[Part Marking]** The storage conflats were going to be marked with tape, embossed tape, or a tag, depending on LLNL DA preference. Direction for marking in accordance with Class H-1 (i.e., footnote B of Table 1 in 9919100) would be provided by the Product Engineer via the traveler.

Issues, Mitigations, and Resolution Actions¹

1. **[Criticality Safety Evaluation of the Storage Conflat]** This evaluation could not be completed to support the Aug-2018 milestone for the EE, thereby precluding the containerization of SNM in the 157Y701733-000 conflats.

Mitigation: The LLNL DA is providing relief on this aspect of the program in the upcoming revision of the EER (20180067LL R2). Pieces of cast aluminum were to be used in place of SNM during the EE.

2. **[Revision of PA-DOP-01118]** PA-DOP-01118 R7, *Assembly Gas Operations* requires modification to accommodate the scope of work for this effort. The changes to the DOP are minor, comprising the addition of a sentence to Section 1.2 (Scope) and the addition of a one-sentence subsection in Section 5 (Performance) that provides continuity between the work authorizing document and the manufacturing work control document (SPI). However, the scope of work (leak testing a container) is not consistent with the criticality safety posting for NMCA Location 307N. Specifically, the Process Description section of PA-CSP-01231 R0, *Dropbox 380 / PF4-307NR-00* allows leak checking of pits and hemishells and backfilling of containers; however, leak checking of containers is not specified/defined/allowed.

Resolution Action: The glovebox owner and Process Engineer are working with Nuclear Criticality Safety to adjudicate required changes to PA-CSP-01231 R0.

3. **[Procurement of a Pressure Transducer]** The MKS transducer on the process gas manifold does not have sufficient gage resolution to verify Note 6B of 9R1341.

Mitigation: DA concurrence to utilize the MKS transducer for the EE was going to be requested through SXN N0319LA2018LA, currently in draft. (The draft SXN also requests clarification on whether the 9R1341 Note 6B requirement is for evacuation to 0.1 torr (absolute) or ≤ 0.1 torr.)

Concurrent Mitigation: A calibrated InstruTech Series 211 Convection Vacuum Gage, Part Number CVM211GGA has been ordered to replace the MKS transducer currently connected to the process gas manifold in the glovebox. The InstruTech transducer has millitorr resolution to accommodate the verification of Note 6B of 9R1341.

4. **[Helium Process Gas]** During the course of process development activities, a signed copy of the Certificate of Acceptance (CoA) for the helium process gas at NMCA Location 307N could not be located. The gas was procured from Scott Specialty Gases in Sep-2005 via Purchase Order 30437-001-05 63. The helium was procured as an Ultra High Pure

¹Mitigation refers to a resolution action that may have been achievable to support the EE during the week of 12-Aug-2018, whereas a Resolution Action refers to an action that has an unknown/undefined completion date.

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commercial grade meeting the requirements of LANL WR specification MS6K0014. Scott Specialty Gases supplied cylinder number 405496 with a CoA to LANL in Oct-2005.

Since 2005, Scott Specialty Gases was procured by Airgas, and Airgas was subsequently procured by Air Liquide. Airgas was contacted in Jun-2018, and they provided an unsigned electronic copy of the CoA for the helium. The information on the unsigned CoA is consistent with information on the helium cylinder.

A signed copy of the CoA was requested from Airgas, but their representative was unable to locate the original or a copy of the signed document (the 2005 procurement date is well beyond their internal document retention requirement of seven years). A significant amount of time was spent attempting to locate a signed copy of the CoA within LANL: Procurement, Production Agency Quality, and personnel at the Gas Plant have been unable to locate a signed copy of the CoA.

The inability to find a signed copy of the CoA for helium used in WR production represents a non-conformance. However, the delivery of an unsigned copy of the CoA from the manufacturer that unambiguously traces to the gas cylinder at LANL represents a minor administrative non-conformance.

Mitigation: Based on the traceability of the CoA to the process gas cylinder, Non-Conformance Report (NCR) N2018-131 has been adjudicated and closed to allow the future use of this gas by the LANL PA. However, the LANL PA does not have concurrence from the LLNL DA on the NCR. This concurrence was to be requested from the DA in SXN N0319LA2018LA, currently in draft.

Concurrent Mitigation: A cylinder of research grade helium (99.9999% minimum purity) has been ordered from Airgas to their published compositional limits. This gas, if delivered in time, would have been used to support the EE during the week of 12-Aug-2018. A White Paper would have been generated showing compliance of the procured helium to the compositional requirements of both LANL specification MS6K0014 (WR specification for helium) and 4526001 (SDS listed on Issue A of 9R1341 and as required by the LLNL DA for Process Material specifications).

Lesson Learned

1. Clinton Peterson, the Process Engineer for Assembly Gas Operations, included a PNID-type diagram in Appendix A of PA-SPI-01173 R0 for the process gas flow and valve system supporting gas operations on the storage conflat, and his plan is to update all Assembly Gas Operations SPIs with this type of information. This diagram is extremely valuable in that it provides a tool to verify steps within the process, acts as a training aide for new operators, and allows non-TSMEs to understand the technical content of the SPI.

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